THURSDAY, DECEMBER 26, 1872

THE PROGRESS OF NATURAL SCIENCE DURING THE LAST TWENTY-FIVE YEARS

I.

On the occasion of the celebration at Breslau of the twenty-fifth anniversary of Prof. Goeppert's presidency of the Silesian Society for National Culture, Prof. Ferdinand Cohn delivered an address characterised by eloquence of the highest kind on the above subject. As the wanderer, he said, who is climbing towards a high mountain peak, feels from time to time the desire to stand still a little, and look back on the way over which he has passed, to enjoy the wider outlook which he gains from his higher stand-point; so he thinks there are moments in the uninterrupted progress of science, when we long in some measure to strike a balance, and see how much acquired property the present puts aside as useless, how much it uses only for temporary purposes, and how many enduring acquisitions have been made.

Dr. Cohn refers, no doubt with justice and some pardonable pride, to the foremost place held by Germany during the last quarter of a century, in the march of science. At the same time he awards due praise to other European states, and above all to England, which, during that time and more particularly at present, he thinks, abounds in men of the highest eminence, whose scientific achievements stand prominently out on account of their astonishing energy, clearness, depth, and independence of thought. Still, we cannot but admit that Dr. Cohn is right in asserting that Germany is free from the dilettantism which abounds in this country, and that as a rule science in Germany is both far more widespread, and far more thorough than it is among ourselves, and that the opportunities furnished there to all classes for scientific study at the ordinary educational establishments have until recently left us almost nowhere. But happily, signs of the beginning of the end of this state of things among us are becoming rife.

After briefly referring to the intellectual awakening of Germany along with the rest of Europe at the time of the Reformation, and showing how this start forward was, especially in the case of Germany, in a great measure frustrated by the Thirty Years' War, Dr. Cohn pays a high and justly-merited tribute to France, and especially to Paris, on account of the supreme place she took during the first thirty or forty years of the present century in nearly all the sciences. The glory of France in this direction has however, he thinks, departed, and Germany is becoming daily more and more the intellectual centre of the world. Had Dr. Cohn written his lecture now, he might have somewhat modified his language; for within the last few months, the signs have been many, that in the direction of science the French are determined to try to hold their own with the foremost in Europe. Their professors are prosecuting an amount of research which puts our own to shame, while they are at the same time forming a school of investigators. We do not grudge to Germany all the praise she well deserves, and the influence which the results of German research exercise on other nations, is likely to urge them to such vigorous and determined efforts, that, sooner or later, science and every other progressive influence shall be "great gainers." Meantime, however, Germany is doubtless in the ascendant.

In the year 1845 appeared the first volume, and in 1846 the second of Humboldt's *Cosmos*. As comprising a view of the whole created universe depicted with the most wonderful sympathy, the book is as it were a canon forming a key to everything that was known of nature at the time. No man was then more suited for such work than was in the highest degree A. von Humboldt. A *Divina Commedia* of science, the *Cosmos* embraced the whole universe in its two spheres, heaven and earth. Under the leadership of the great searcher of Nature, as Dante once by the hand of Virgil, we climb from the depths of the universe, with its furthest nebulæ and double stars, down through the star depths to which belongs our solar system, to the air and sea-enveloped earth, where form, temperature and magnetic condition are unveiled to us; then to the wealth of organic life, which, stimulated by the light, unfolds itself on its surface. It is an overwhelming picture of nature, of surpassing beauty of outline, abounding in grand perspective, with the most careful execution of the smallest detail.

But we cannot conceal from ourselves that the *Cosmos*, published twenty-five years ago, is in many of its parts now antiquated, not merely because it is wanting in many facts which have since been discovered, but most particularly because Humboldt was ignorant of some highly important questions which have since taken their place in the foreground of scientific discussion, while our scheme of the universe during the last ten years has been considerably modified by the introduction of new and influential ideas. Any one who to-day would attempt to recast the *Cosmos*, must proceed like the Italian architect who took the pillars and blocks of the broken temples of antiquity, added new ones, and rebuilt the whole after a new plan.

There are three discoveries which during the last quarter of a century have entirely changed the position of natural science:—the mechanical equivalent of heat, spectrum analysis, and the Darwinian theories.

Since, in the year 1842, an unknown physician in a Swabian country town, Dr. Mayer of Heilbronn, pointed out that a hammer 424 kilograms in weight, which falls from the height of a metre on an anvil, raises the heat of the latter by one degree centigrade, and that by this process of bringing a falling motion to a stand-still it is converted into a fixed quantity of heat—since then has science gained a new conception of the conditions of matter and of the powers of nature. This new doctrine appears in the mechanical theory of heat announced by Joule, Krönig, Maxwell, and Clausius, in the doctrine of the conservation of energy of Helmholtz and Thomson, and by means of the brilliant writings of Tyndall it has become the common property of the educated world. Electricity and magnetism, heat and light, muscular energy and chemical attraction, motion and mechanical work—all forces in the universe are only different forms of one and the same power, which has dwelt from the first in matter in invariable quantity, neither increased nor diminished. not the least trifle of it can be annihilated or created Only the phenomenal forms of power are changeable;

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light can be converted into a chemical equivalent, this again into heat, heat into motion, and indeed a fixed quantity of one force always and only into an equivalent quantity of another. In like manner also the quantity of matter has remained unchanged from the beginning; not the least particle or molecule can be annihilated or created out of nothing, and only in the transformation of perishable bodies are the molecules formed into ever new combinations. What we distinguish as natural forces are only movements of molecules, for the least particles of matter out of which bodies are composed are not inseparably united to each other, but are loosely held together and in continuous whirling and undulatory motion; according to the swiftness and width of undulation of the molecule will this motion of our nerves be regarded now as sound, now as heat, then as light or as colour. Moreover, the chemical union of the elements of matter, the attractive power of gravitation in all the bodies of the universe, are but varied forms of this universal motive force. The unity and permanency of substance with its two attributes, matter and force, and their innumerable modifications, which go to form the bodies of the universe, were in the first instance enunciated as a philosophical maxim by the great thinker Spinoza. Now it is established as a philosophic fact by means of exact measure and weight.

Again, on the inner organisation of the system of the universe has unexampled light been thrown by the wonderful researches which were begun in 1859 by two men, united by the closest bonds of a friendship which bore rich fruit for science. After the light of the sun had, in the third decade of this century, been brought into the service of art by Nièpce and Daguerre, Bunsen and Kirchhoff* compelled it also to render service to chemistry and astronomy. Like those magicians of the legend, who, through the power of their knowledge, compelled the spirits of the elements to disclose their most recondite secrets, the genius of these men compelled the rays of light imprisoned in the spectrum apparatus to make revelation of things in the world of stars which the curiosity of men had deemed for ever inaccessible. Already had Kirchhoff ascertained what terrestrial elements were present in the sun's atmosphere, and what were not; quite recently has it been discovered that there is even present in the sun a substance (*helium*) which hitherto has been unknown on the earth. Moreover also, the inner structure of the sun, the distribution of its incandescent, liquid, and gaseous parts, its luminous and coloured envelope, the nature of its spots and protuberances—all this is no longer a playground for fantastic imaginings, but the subject of exact research. Since the great eclipse of 1868, Lockyer and Janssen, Zöllner, Huggins, and Father Secchi have observed, day after day, storms, whirlwinds, flame-sheaves, outbursts of burning hydrogen to the height of 20,000 miles: thus has been developed an entirely new science—the meteorology of the sun. Moreover, on other obscure regions of the heavens, on the physical and chemical conditions, even on the laws of the movements of the fixed and double stars, on nebulæ and milky ways, on planets and comets, on zodiacal and northern lights, has spectrum analysis thrown its enlightening rays. No less by rigorous mathematical method, through which astronomy, even at an earlier period, had been brought to a certain amount of perfection, has she in the most recent time enjoyed an unexpected triumph, by solving, through the researches of Schiaparelli, the riddle of the comets, in being able to recognise the identity of their nature with that of the swarms of shooting-stars whose remarkable brilliancy long ago made them universally known.

(*To be continued.*)

EXPLORATION OF THE SOUTH POLAR REGIONS

III.

At the conclusion of the last article the drifting seaweed was referred to as an important element in enabling us to ascertain the state of the sea about the Antarctic regions. Let us now see whether the conditions of temperature, so far as they have yet been determined, are in harmony with the ideas already developed. By reducing the ascertained directions for all the months of the year to a mean, there is obtained for the maximum of the temperature a curve which coincides with the intersections of the following meridians and parallels of latitude:—

33° S. lat. and	33° E. long.	44° S. lat. and	65° E. long
35 „	35 „	46 „	67 „
37 „	40 „	47 „	68 „
38 „	43 „	48 „	70 „
39 „	47 „	49 „	71 „
40 „	50 „	50 „	73 „
41 „	55 „	51 „	73 „
42 „	60 „	52 „	74 „
43 „	63 „	53 „	75 „

A glance at a map shows that this curve leads into the midst of the ice-free field, and is only distorted somewhat from its regular course by Kerguelen Island. This curve can be followed even as far as Macdonald Island, which is of high importance, inasmuch as it can be proved from direct observation that a higher temperature of the water exists in these regions, as Dr. Neumayer himself has witnessed. When he, in December and January, 1856-57, was sailing about 53° S. lat., he proved from hourly observations that there was an influx of a warm current between 62° and 72° E. long.

With respect to the higher temperature in the Pacific Ocean, it suffices to mention the circumstance that there exists on the Falkland and Campbell Islands a richer vegetable and animal life than is the case on other islands in the same latitude of the hemisphere. The unusual mildness of the regions is to be ascribed to the neighbourhood of the Australian continent, as well as to the prevailing west and north-west winds. If, on the other hand, a much poorer flora is found on Kerguelen Island than on the Auckland Islands, and if we should be at first inclined to regard this as evidence against the milder influx of warm currents, it should not be forgotten that Kerguelen does not enjoy the warming influence of a great continent, since it lies in the midst of the Indian Ocean, almost equidistant from the two nearest continents, and more than double the distance of the Auckland Islands from Australia. Both around New Zealand and near Kerguelen and south from Cape Horn, the cachelot (*Physeter macrocephalus*), which, it is known, seeks out the warmer waters, is found in abundance.

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* In connection with this discovery it would have been a graceful act on the part of our author to have referred to the names of Stokes and Stewart.—Ed.

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